

Ebola Virus Disease: The African Experience

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Regional Ebola Training

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Outline

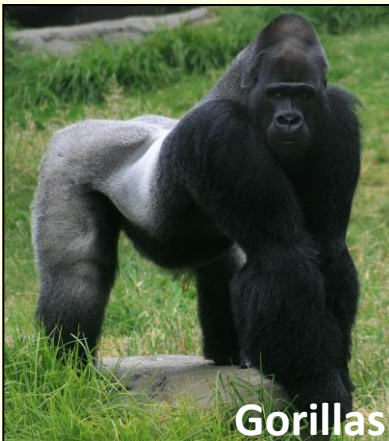
- **Ecology & epidemiology of Ebola virus disease (EVD)**
 - Natural cycle of EVD in Africa and ways of transmission
- **1976 outbreaks in Sudan and Zaire**
 - Person-to-person and common source transmission
- **2014 outbreak in West Africa**
 - Summary and update
 - The “RITE” stuff
 - How Nigeria became Ebola-free
- **Food for thought**

- **One of many viral hemorrhagic fever diseases**
 - Marburg, Lassa, Crimean-Congo
- **First identified in 1976**
 - Democratic Republic of Congo and South Sudan
- **Five subtypes**
 - Zaire, Sudan, Taï Forest, Bundibugyo, and Reston
 - Reston does not cause disease in humans
- **Case fatality rates vary (as high as 100%)**
 - Based on viral subtype, population density, and control and prevention
- **There is no cure for Ebola**

True or False?

Ebola virus disease is a zoonotic disease.

TRUE



Gorillas



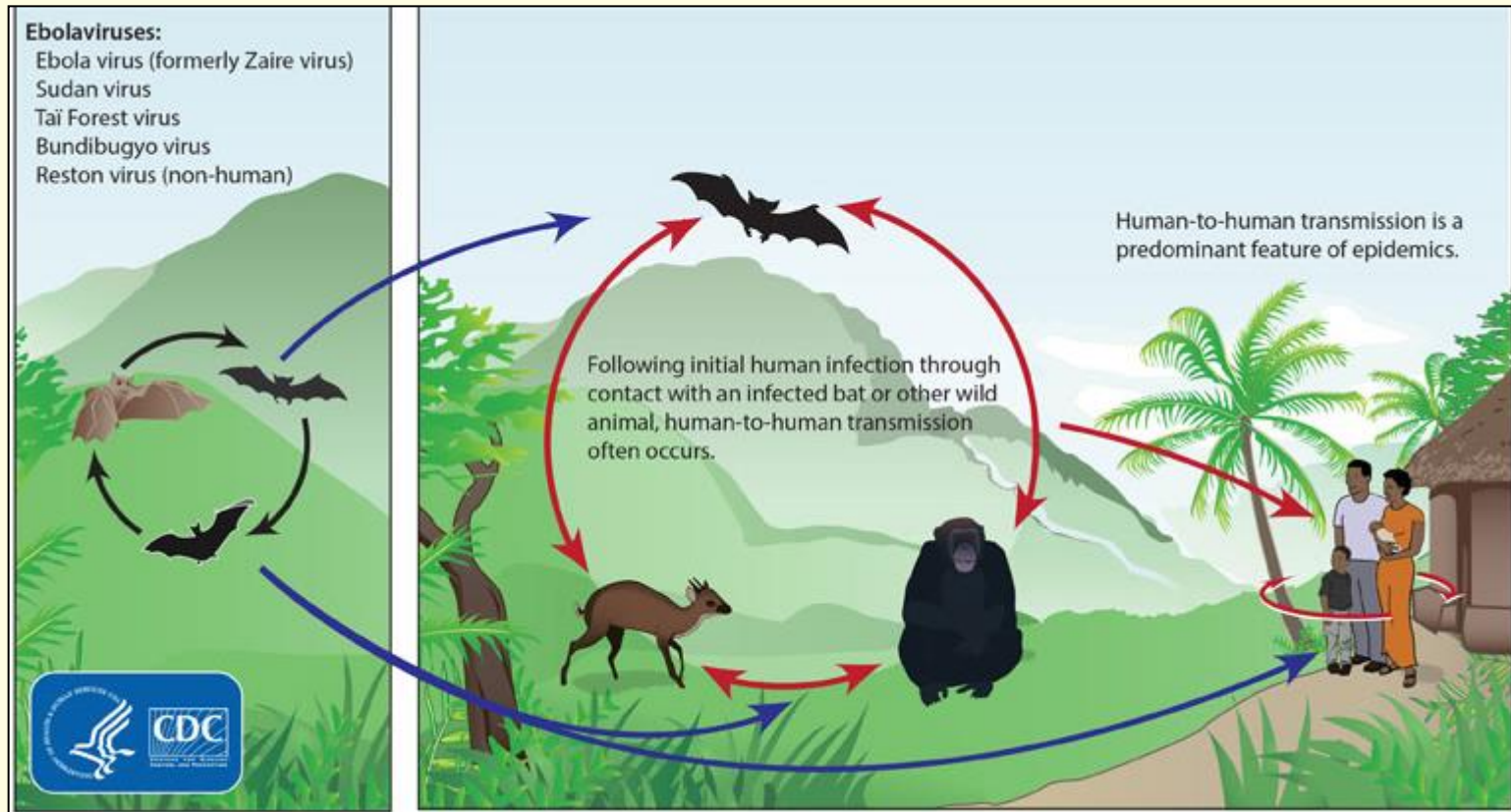
Fruit bats



Duikers

EVD Ecology

Evidence strongly points to bats as the reservoir hosts for Ebola viruses.



True or False?

Ebola is spread through the air.

FALSE

Ebola is NOT spread through the air, water, or mosquitoes. (CDC)

Airborne vs. Droplet Spread



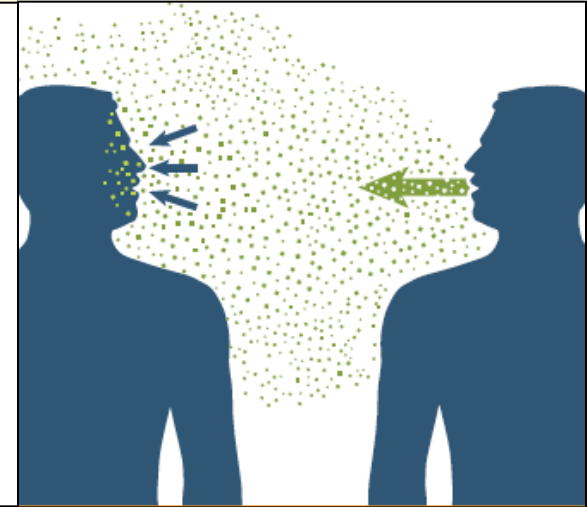
Airborne spread happens when germs float through the air after a person talks, coughs, or sneezes. Those germs can be inhaled even after the original person is no longer nearby. Direct contact with the infectious person is NOT needed for someone else to get sick.

What are some diseases that are spread this way?

Examples: chickenpox, measles, and TB

Airborne vs. Droplet Spread

Droplet spread happens when fluids in large droplets from a sick person splash the eyes, nose, or mouth of another person or through a cut in the skin. Droplets may cause short-term environmental contamination.



What are some diseases that are spread this way?

Examples: pertussis, influenza, and Ebola

How is EVD spread?

Ebola virus detected by RT-PCR in body fluids.

Body Fluid	Days after symptom onset when virus was detected
Skin	6
Saliva	8
Urine	23
Stool/Feces	29
Breast milk	15
Semen	101 ¹
Vaginal fluid	33

¹Sexual transmission of Marburg virus (but not Ebola virus) has been described.

How is EVD spread?

Person-to-person transmission

- Direct contact with body fluids from an infected person
- Alive or deceased

Common source

- Medical/laboratory supplies contaminated with the virus
- Soiled items (eg. personal protective equipment, linens)

Spillover events (animals → humans)

- Direct contact with infected animals leads to illness in humans
- Touching or consumption of “bushmeat”

How is EVD spread?



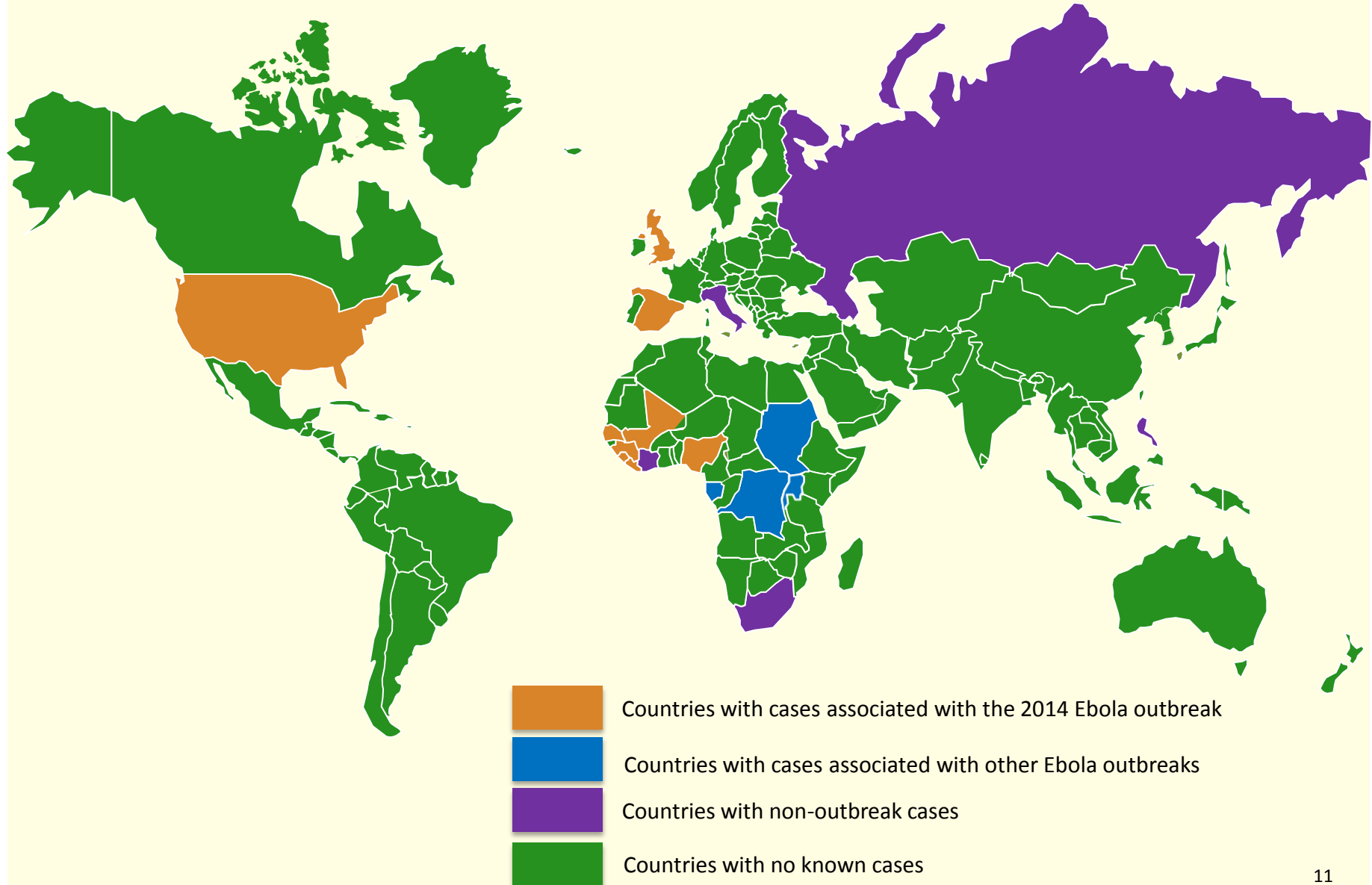
Monkeys and bats are common sources of bushmeat.

- “Bushmeat” comes from wild animals, including bats, non-human primates, rats, and duikers.
- It is often smoked/dried/salted and considered a main food source to some.
- In Africa, EVD has been associated with hunting, butchering, and processing meat from infected animals.



Courtesy BBC

Countries with Human Cases of EVD

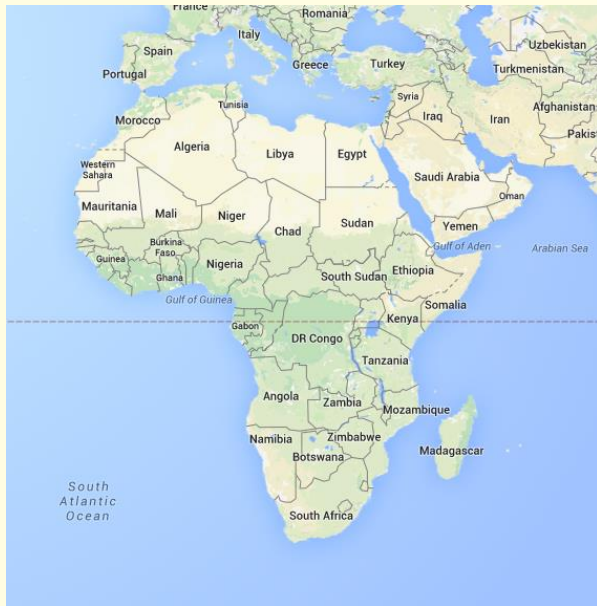


Multiple Choice

Which six African countries are associated with the recent 2014 Ebola outbreak?

- A. Guinea-Bissau, Sierra Leone, Congo, Mali, Nigeria, and Senegal**
- B. Guinea, Sierra Leone, Liberia, Mali, Nigeria, and Senegal**
- C. Guinea, South Africa, Liberia, Mali, Nigeria, and Senegal**
- D. Guinea, Sierra Leone, Liberia, Sudan, Nigeria, and Senegal**

Current Outbreak Countries



Liberia was declared Ebola-free as of May 9th, 2015.

True or False?

Ebola has a high potential for spread in healthcare settings.

TRUE

There have been Ebola infections among healthcare workers in almost every outbreak of EVD. Infection control is a key strategy in stopping the Ebola epidemic. (Source: CDC)

1976 Outbreaks: Sudan and Zaire



1976 EVD Outbreak - Sudan



1976 EVD Outbreak - Sudan

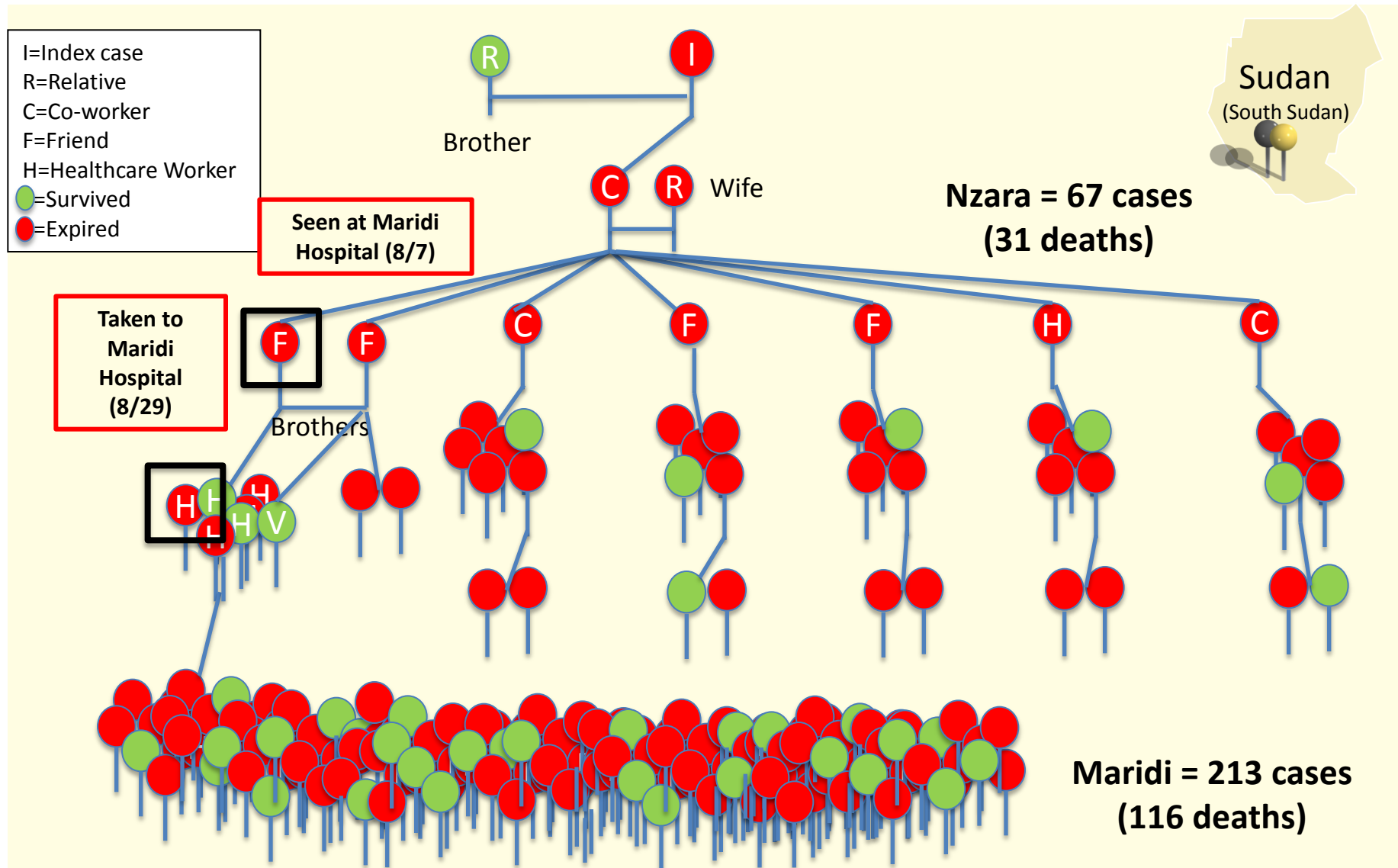
June – November 1976



Index case: cotton factory storekeeper in Nzara, Sudan

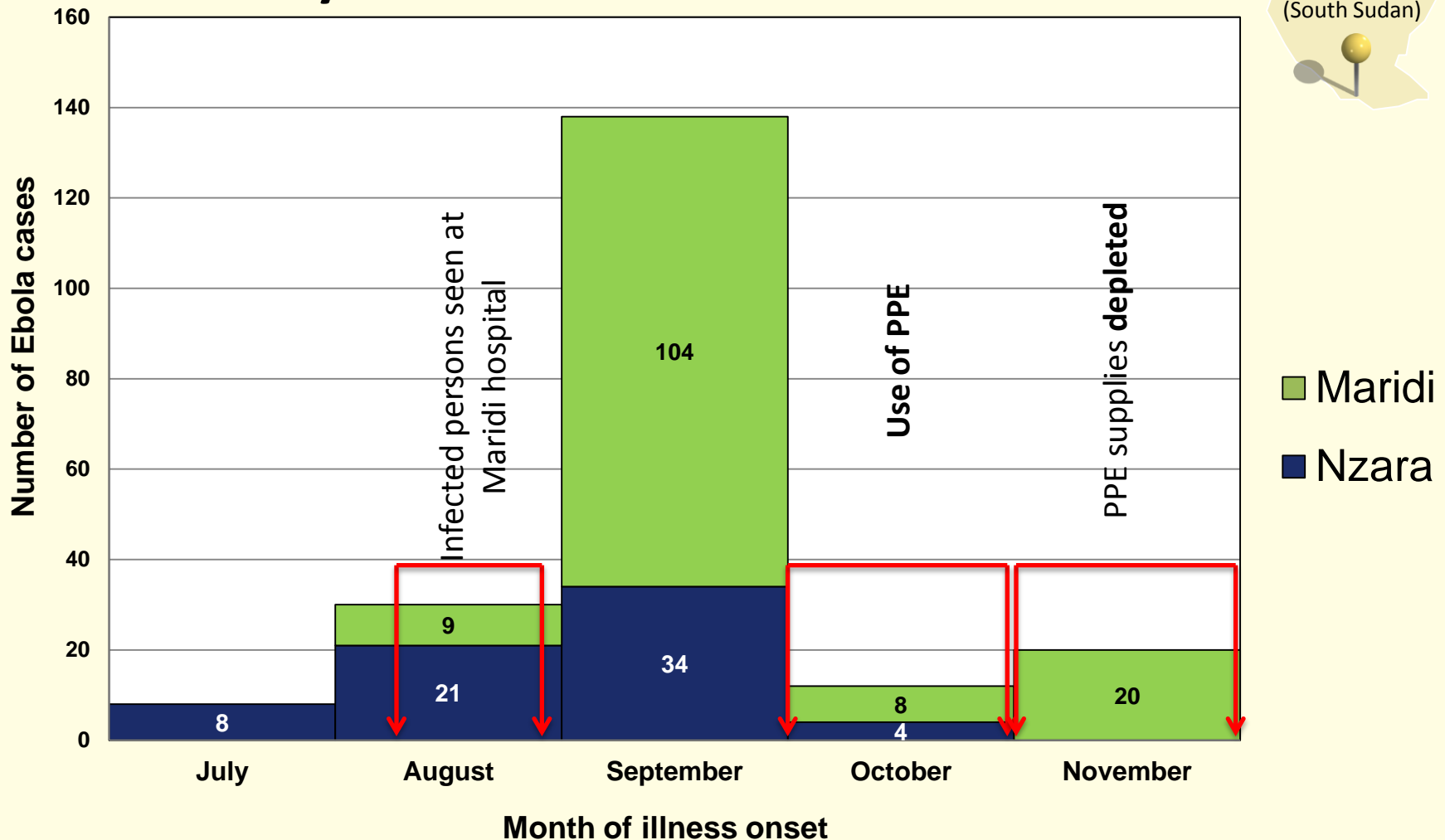
June 27	Case became ill with fever, headache, and chest pains.
June 30	Case admitted to hospital in Nzara.
July 2	Case developed hemorrhagic manifestations (bled from nose, mouth, and bloody diarrhea).
July 6	Case expired.

1976 EVD Outbreak - Sudan



1976 EVD Outbreak - Sudan

Cases by month of onset and location



1976 EVD Outbreak - Sudan

Cases by source of infection and location



Location	Total # of cases	Source of infection (% of total)		
		<i>Hospital-acquired</i>	<i>Within Household</i>	<i>Unknown</i>
Nzara	67	2 (3%)	51 (76%)	14 (21%)
Maridi	203	93 (46%)	105 (52%)	5 (2%)
Other	4	1	3	0
Total	274	96 (35%)	160 (58%)	18 (7%)

41 staff members at the Maridi hospital died of Ebola.

Casual vs. Direct Contact with Cases

Maridi, Sudan



Attack rate among household contacts who slept in the same room

Risk factor	# of contacts at risk	# of contacts that developed Ebola	Attack rate
Touched patient with Ebola	23	5	23%
Nursed patient with Ebola	48	39	81%

1976 EVD Outbreak - Sudan

June 27 – November 20: 284 cases



Case fatality rate: 53% (151/284)

Transmission: person-to-person

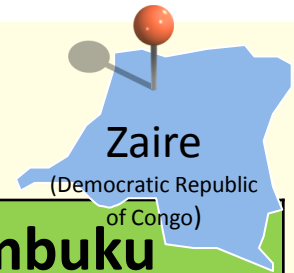
- self-limiting infections due to distance (Nzara)
- high morbidity and mortality in healthcare workers (Maridi)
- outbreak contained with strict barrier nursing, use of PPE, and isolation of ill patients

1976 Ebola Outbreak- Zaire



1976 Ebola Outbreak - Zaire

September 1 – October 24: 318 cases

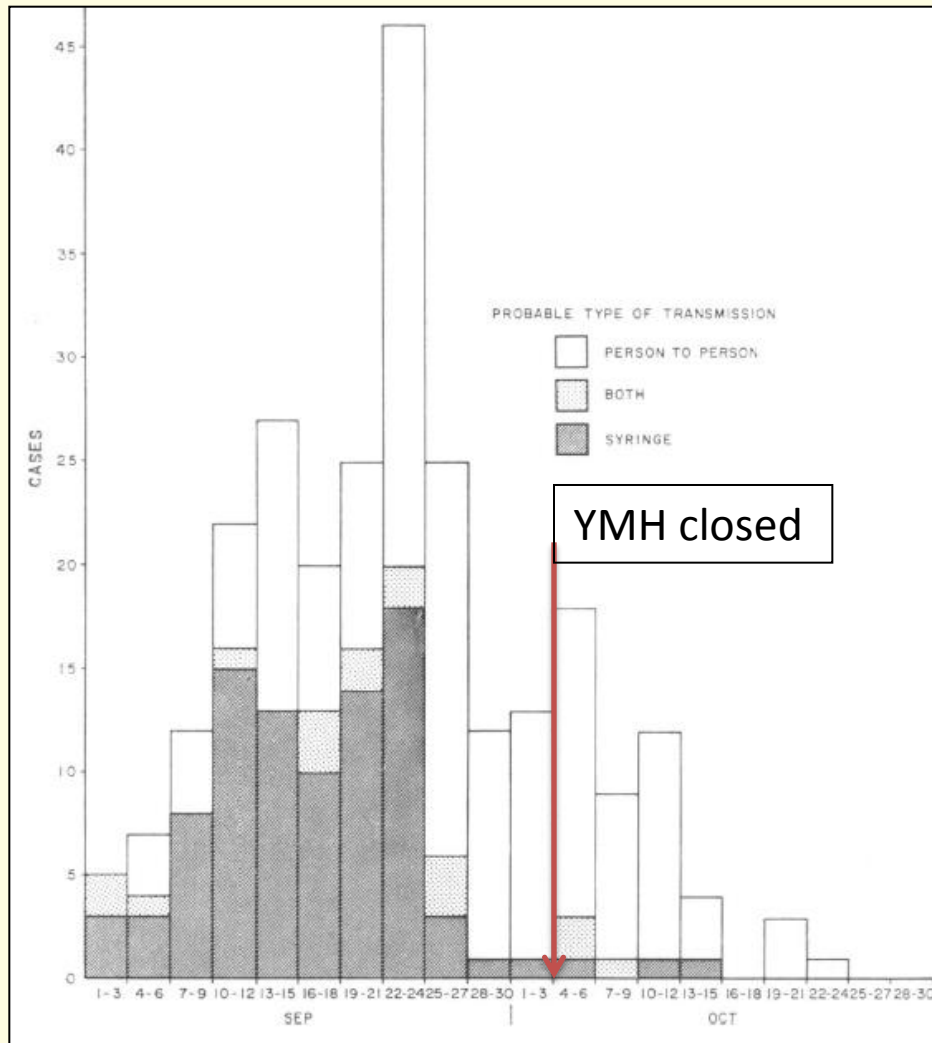
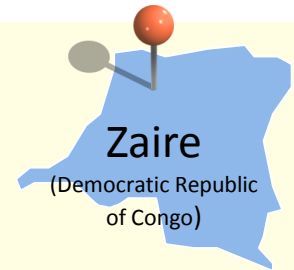


Index case: teacher at Catholic mission school in Yambuku

August 22	Case bought fresh and smoked antelope and bushmeat.
August 26	Case had febrile illness thought to be malaria; given chloroquine by parenteral injection.
August 27-31	Case was afebrile.
September 1	Case developed a fever of 102.6°F.
September 5	Case admitted to the Yambuku Medical Hospital (YMH) with GI symptoms.
September 8	Case expired.

1976 EVD Outbreak - Zaire

Cases by onset and transmission source

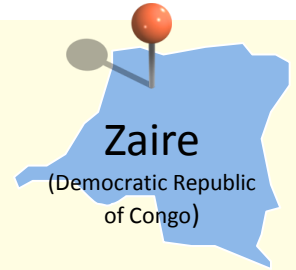


“Indeed, it seems likely that closure of YMH was the single event of greatest importance in the eventual termination of the outbreak.”

13/17 staff infected (11 died)

1976 EVD Outbreak - Zaire

September 1 – October 24: 318 cases



Affected area: Yambuku and surrounding villages, Kinshasa

Case fatality rate: 88% (280/318)

Transmission: common source

- improperly sterilized equipment used
- outbreak waned when hospital closed (see epi-curve)

1976 EVD Outbreak - Zaire

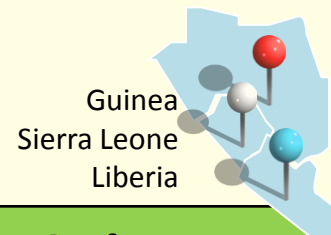


2014 EVD Outbreak- West Africa



CDC/Dr. Heidi Soeters

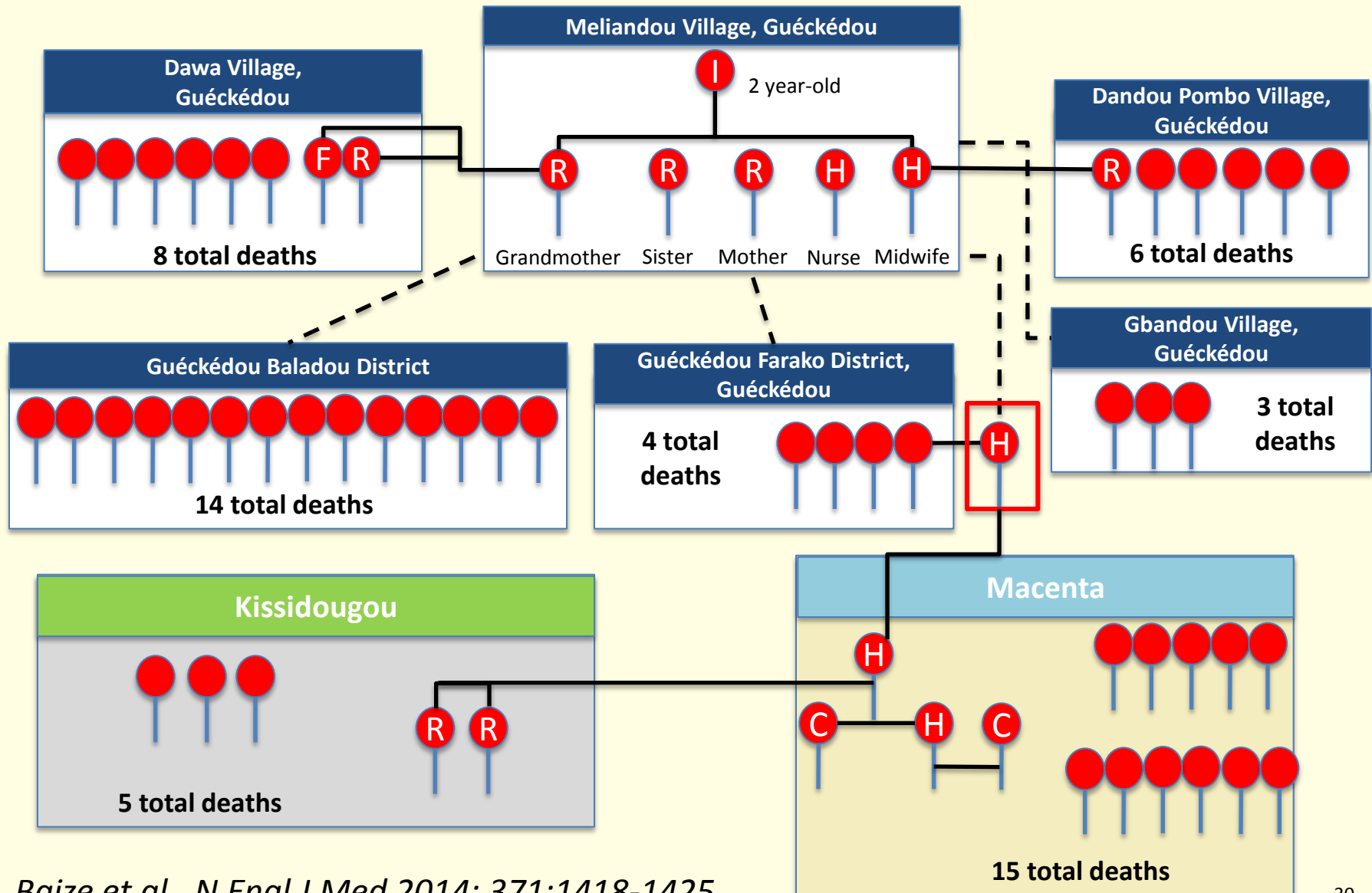
2014 EVD Outbreak- West Africa



Suspected index case: 2 year-old boy in Meliandou, Guinea

December 2	Case had fever, black stool, and vomiting.
December 6	Case expired.
December 13	Mother of index case expired.
December 29	3 year-old sister of index case expired.
January 1	Grandmother of case expired.
February 10	Healthcare worker in Macenta (60 miles away) expired.

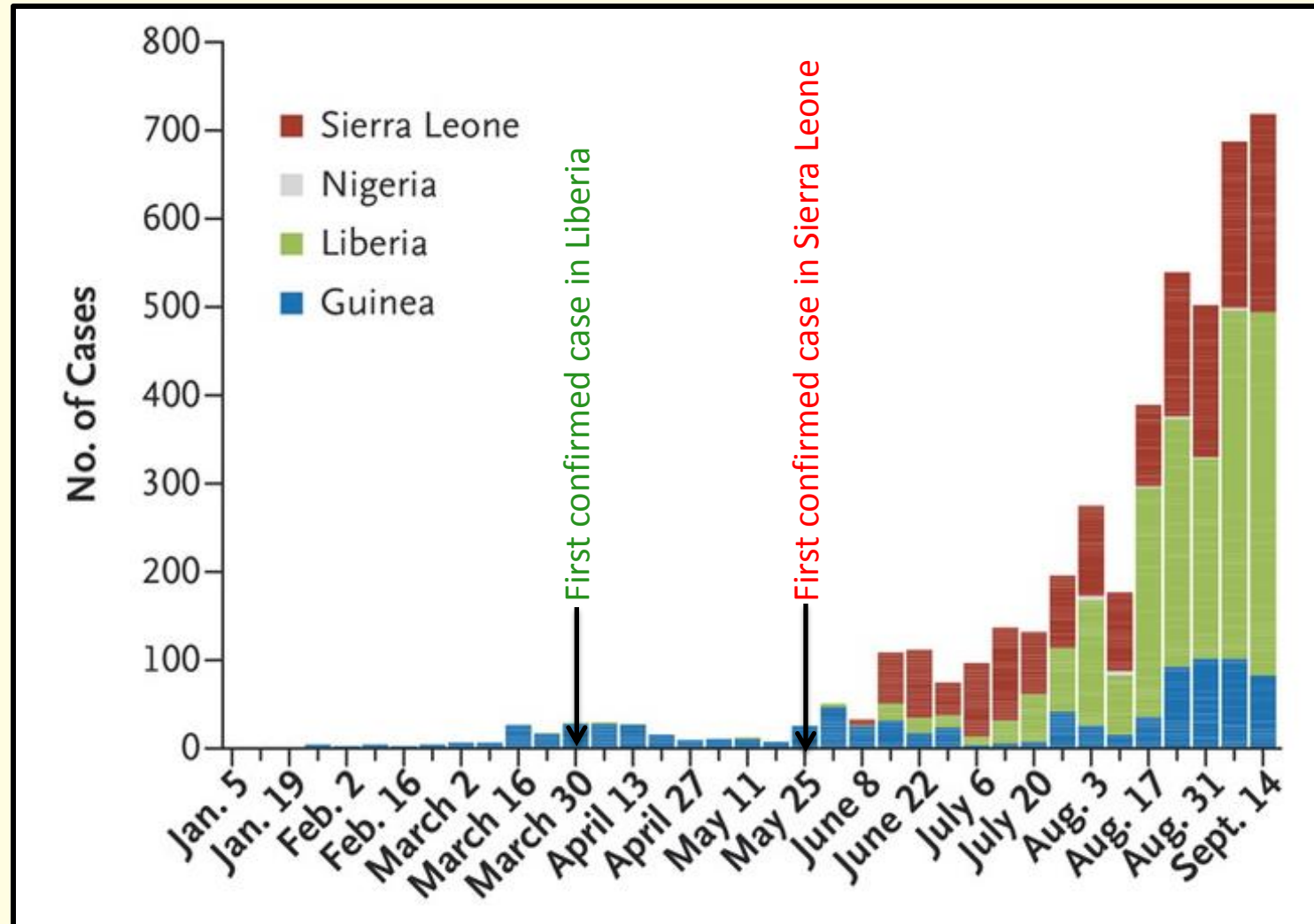
2014 EVD Outbreak - Guinea



Baize et al., N Engl J Med 2014; 371:1418-1425

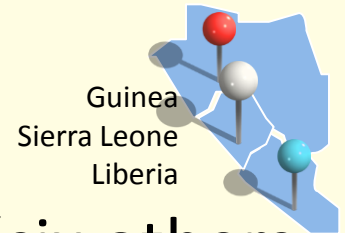
2014 EVD Outbreak - West Africa

Weekly Incidence of Total EVD Cases



2014 EVD Outbreak - West Africa

December 6, 2013 - Present: 26,823+ cases



Affected area: predominantly three countries (six others with at least one case in country)

Case fatality rate: 41.3% (12,080/26,823)

Transmission: person-to-person

- Travel to neighboring villages/across country borders
- Direct care of infected persons
- Intimate funeral ceremonies
- Fear and misinformation

True or False?

The 2014 Ebola outbreak is just about over.

NOT JUST YET

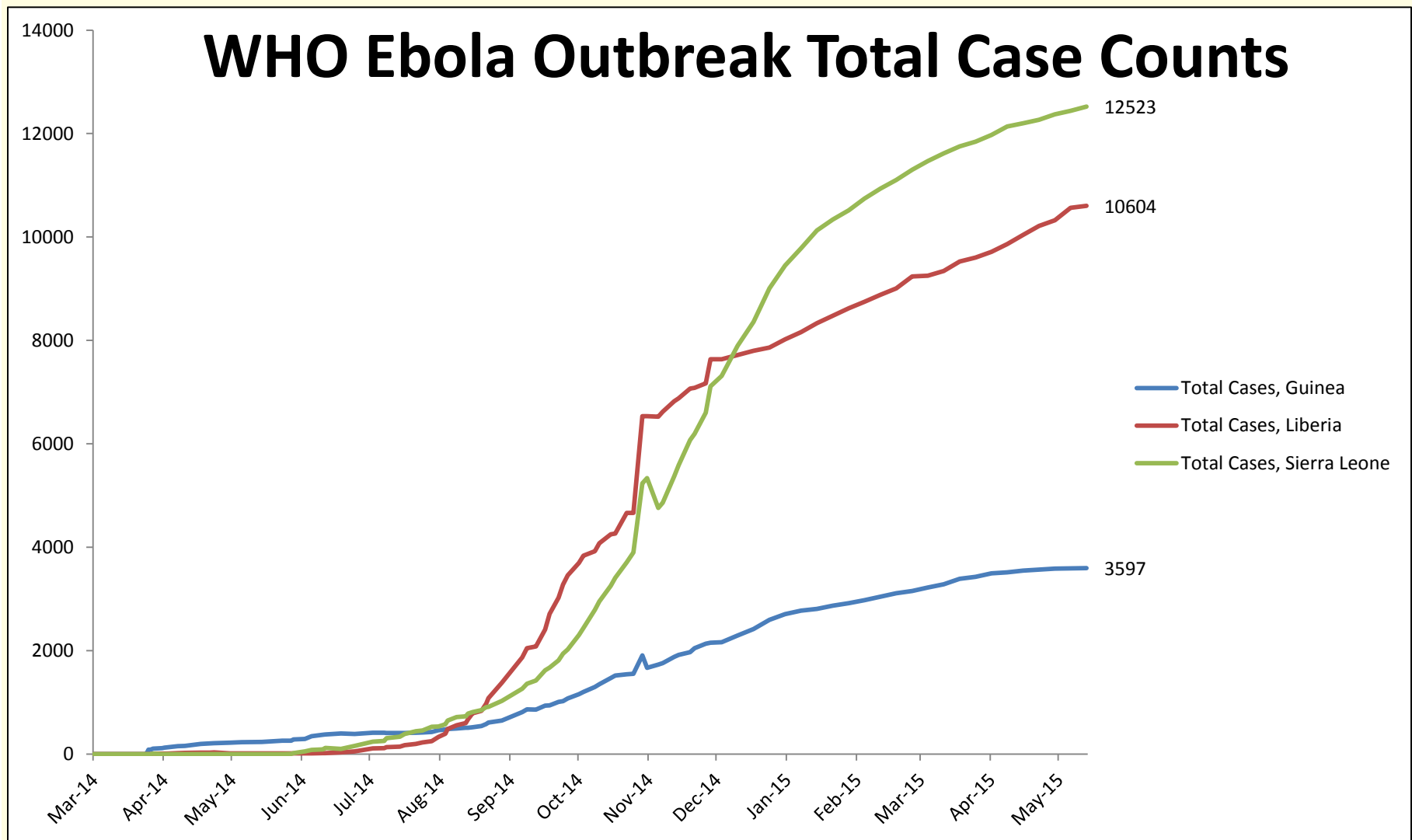
“En route to West Africa. Real progress but still many challenges ahead to get to zero cases of Ebola.”

-March 04, 2015 tweet from Dr. Tom Frieden (CDC Director)

Total EVD Cases and Deaths

Country	As of November 14, 2014		As of April 21, 2015	
	Total # of cases	Total # of deaths	Total # of cases	Total # of deaths
<i>Countries with widespread transmission cases or with former widespread transmission and current, established control measures</i>				
Guinea	1,971	1,192	3626	2,405
Liberia	7,069	2,964	10,604	4769
Sierra Leone	6,073	1,250	12,593	3,906
Total	15,113	5,406	26,823	11,080
<i>Previously Affected Countries</i>				
Nigeria	20	8	20	8
Senegal	1	0	1	0
Spain	1	0	1	0
Mali	6	5	8	6
United States	4	1	4	1
United Kingdom	0	0	1	0
Total	22	8	35	15

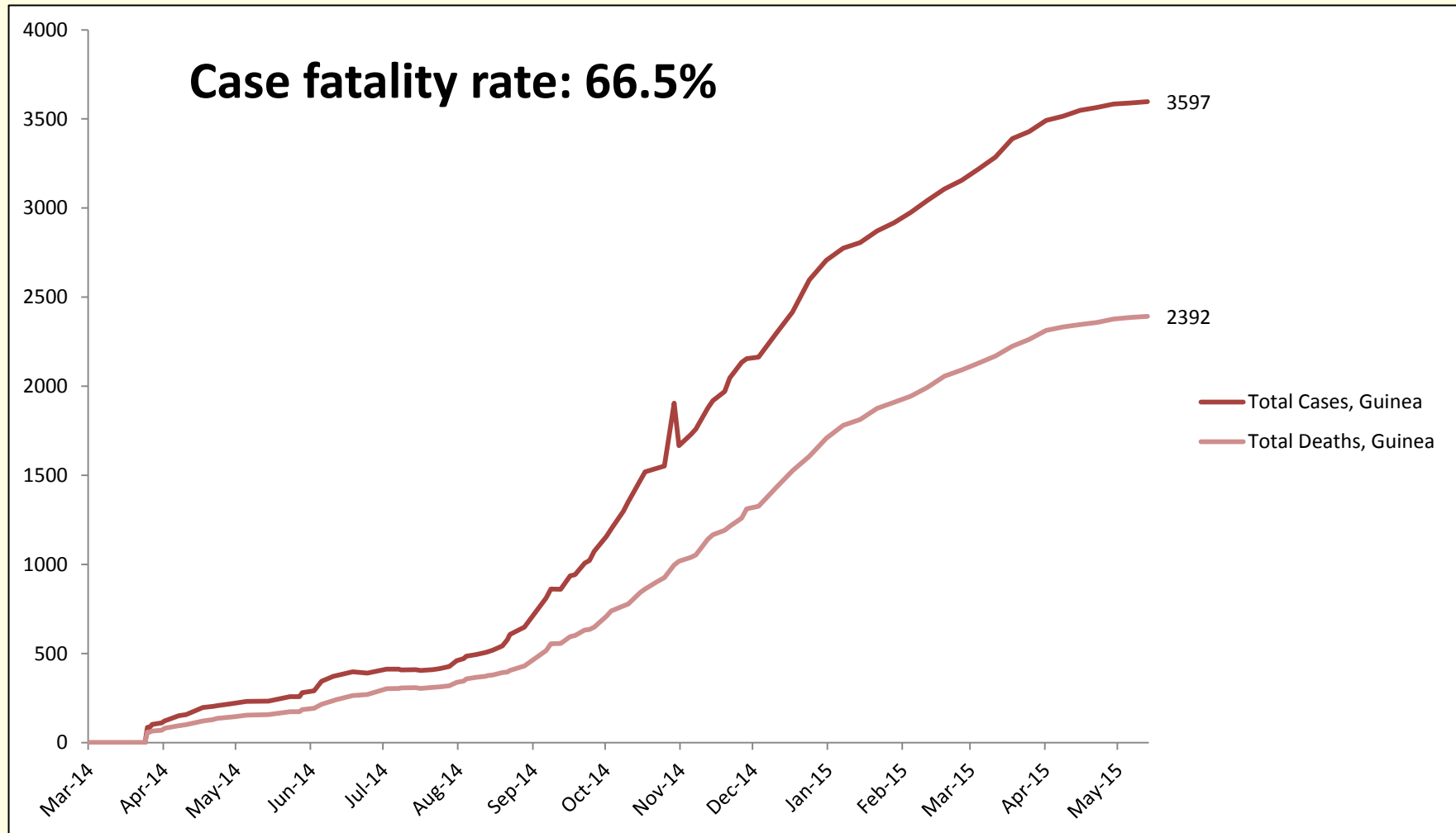
2014 EVD Outbreak - West Africa



<http://www.cdc.gov/vhf/ebola/outbreaks/2014-west-africa/cumulative-cases-graphs.html>

2014 EVD Outbreak - West Africa

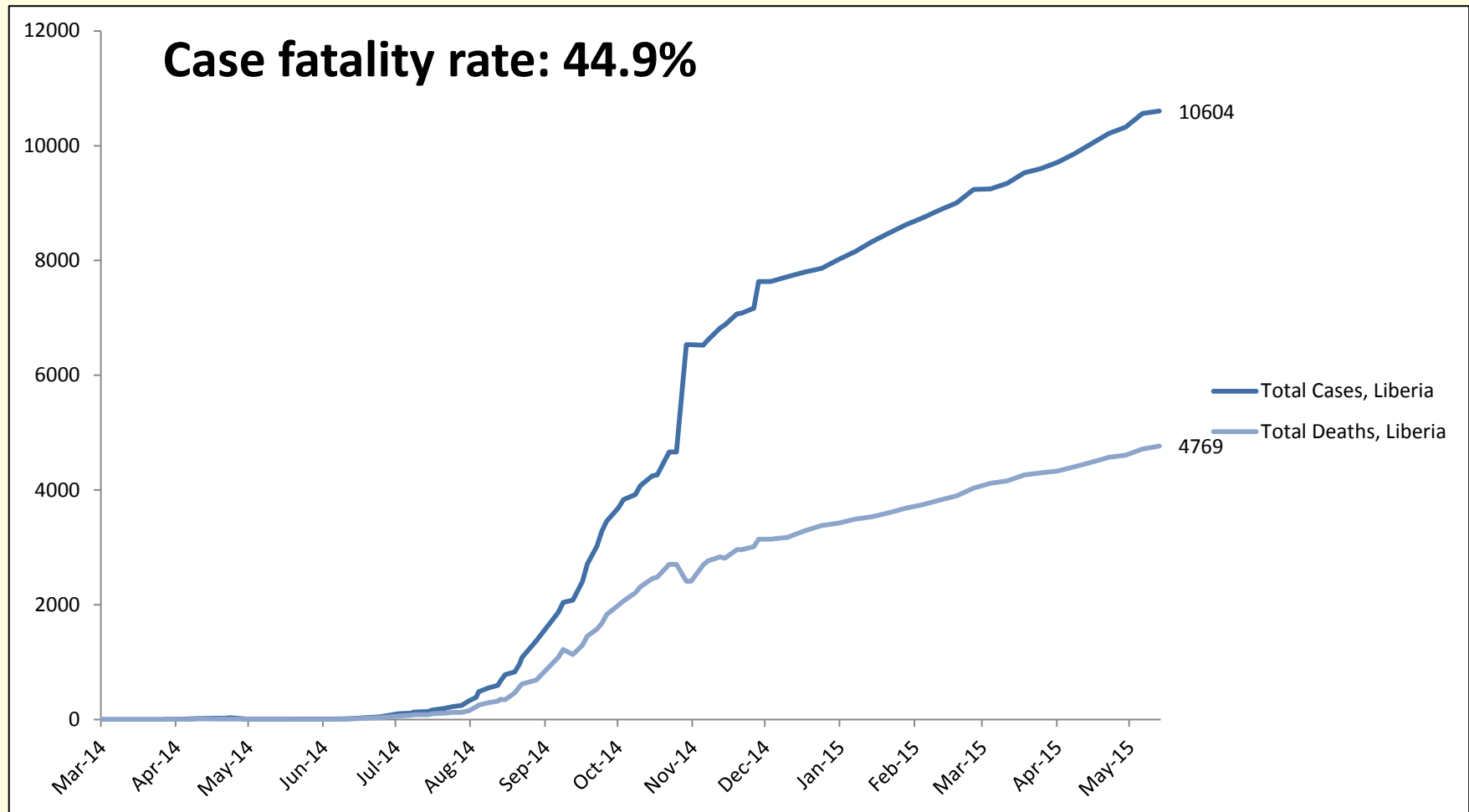
Total cases and deaths in Guinea (through 5/10/15)



<http://www.cdc.gov/vhf/ebola/outbreaks/2014-west-africa/cumulative-cases-graphs.html>

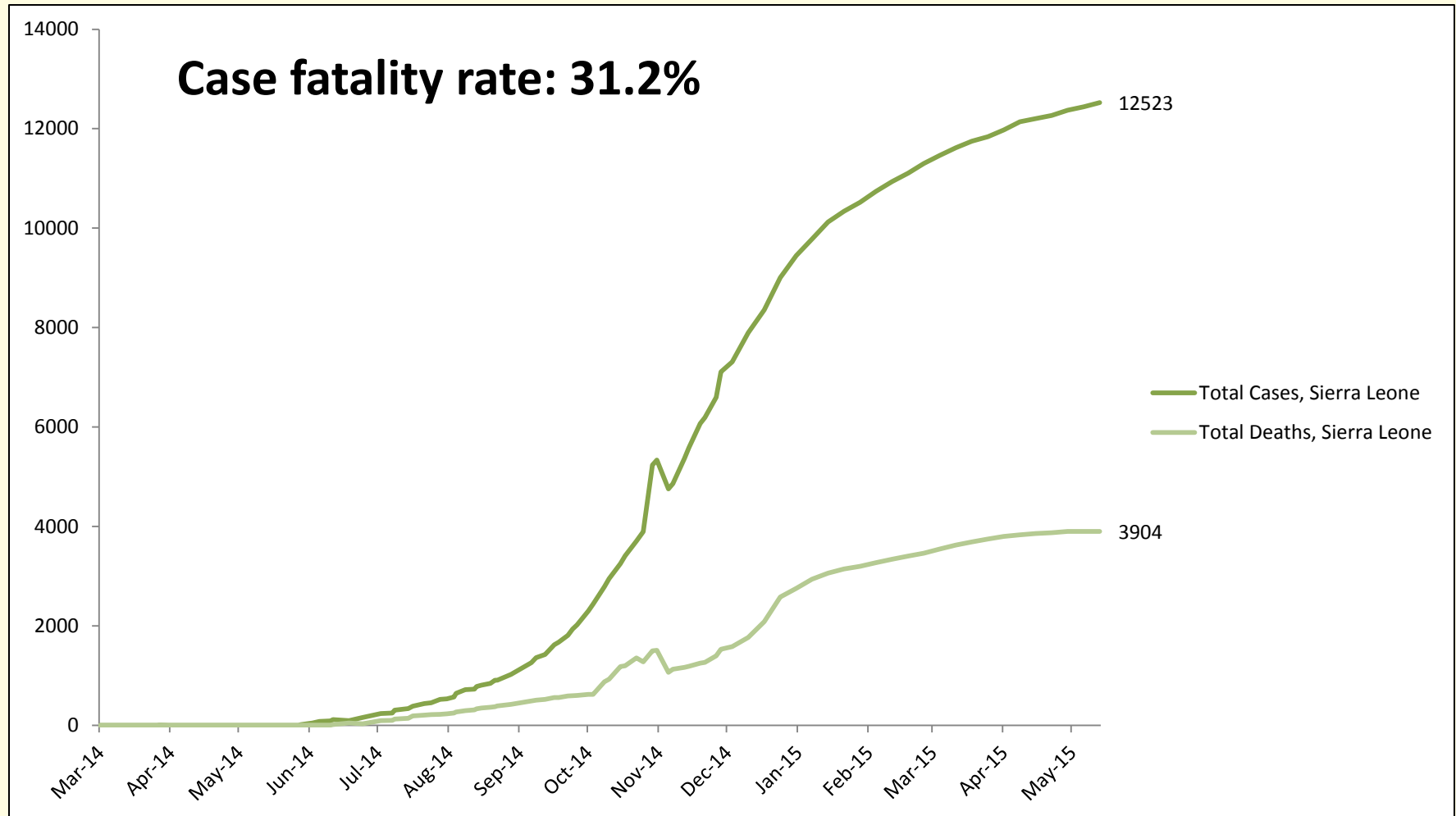
2014 EVD Outbreak - West Africa

Total cases and deaths in Liberia (through 5/10/15)



2014 EVD Outbreak - West Africa

Total cases and deaths in Sierra Leone (through 5/10/15)



2014 EVD Outbreak - West Africa

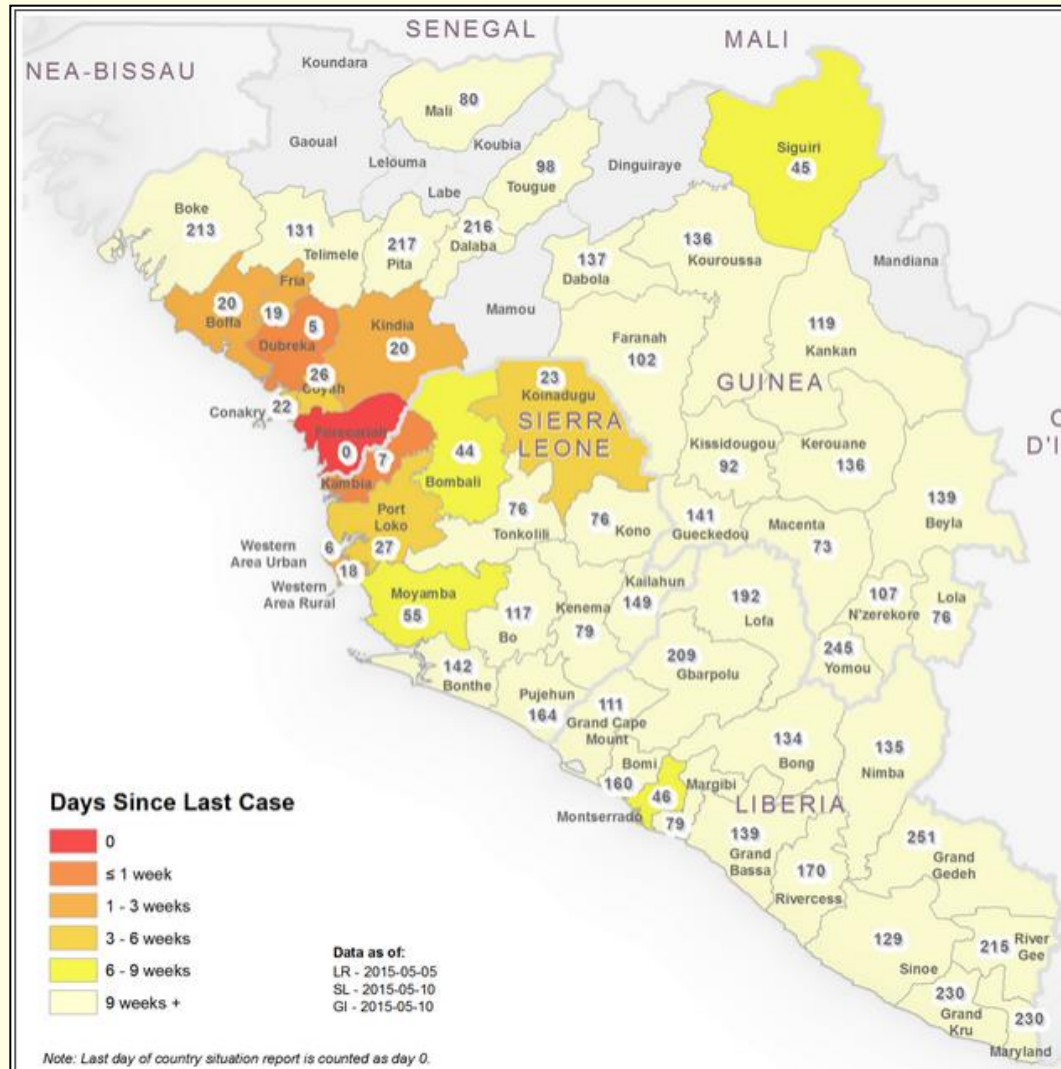
Characteristics of cases who died from Ebola (through 9/14/14)

	Guinea		Liberia		Sierra Leone		Total	
	Rate	# of patients	Rate	# of patients	Rate	# of patients	Rate	# of patients
Case fatality rate								
All cases	57.5	677	34.7	1,616	31.6	1,439	37.7	3,747
Sex								
<i>Male</i>	68.5	254	74.9	395	71.9	221	72.2	874
<i>Female</i>	72.7	286	71.6	317	64.4	208	69.9	818
Age								
<15 years	78.1	73	70.7	82	71.4	63	73.4	218
15-44 years	64.9	319	70.6	422	61.4	264	66.1	1,012
≥45 years	78.6	140	81.1	164	82.2	90	80.4	398
Occupation								
<i>Healthcare worker</i>	56.1	41	80.0	65	68.4	57	69.4	170
<i>Non-healthcare worker</i>	71.9	501	71.5	674	69.1	388	70.9	1,567

WHO Ebola Response Team. N Engl J Med 2014;371:1481-1495.

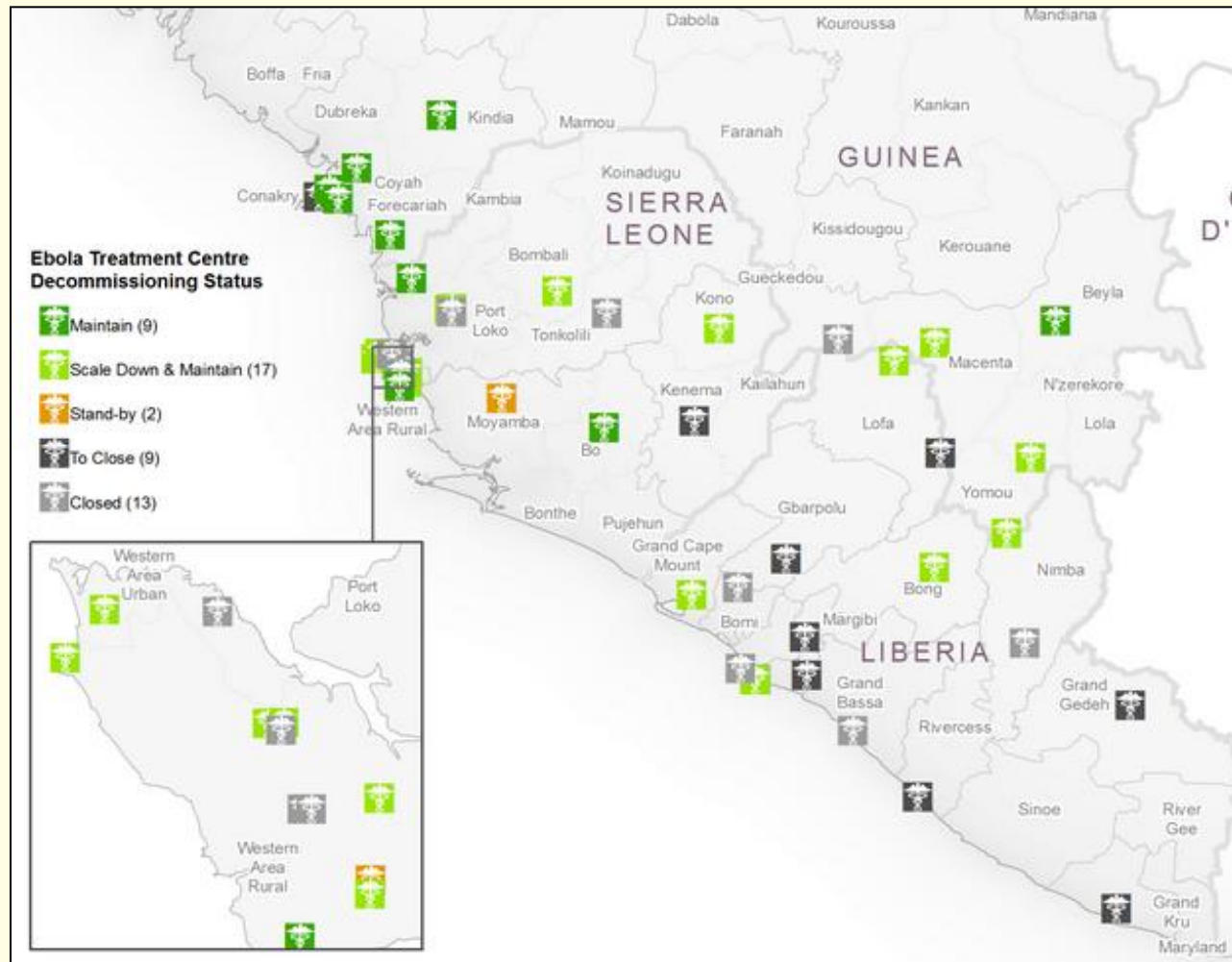
2014 EVD Outbreak - West Africa

Geographic distribution of new cases



2014 EVD Outbreak - West Africa

Location of Ebola treatment centers



The “RITE” Stuff: Controlling Ebola

Liberia

**Rapid Isolation and
Treatment of Ebola**

RITE in Liberia

**After RITE, Ebola
survival increased
from 11% to
50%.**



The “RITE” Stuff: Controlling Ebola

Rapid Isolation and Treatment of Ebola



- Enhances the ability of county health teams (CHTs) to investigate outbreaks in remote regions.
- Multinational and multiagency
 - Liberia Ministry of Health and Social Welfare, CDC, WHO, UNICEF, etc.

The “RITE” Stuff: Controlling Ebola

Objectives of County Health Teams

1. Rapidly isolate and treat Ebola patients.
2. Ensure proper/safe collection and transport of samples.
3. Ascertain the index case.
4. Identify all generations of cases.
5. Train teams in safe burial procedures.
6. Observe contacts for 21 days.

Liberia

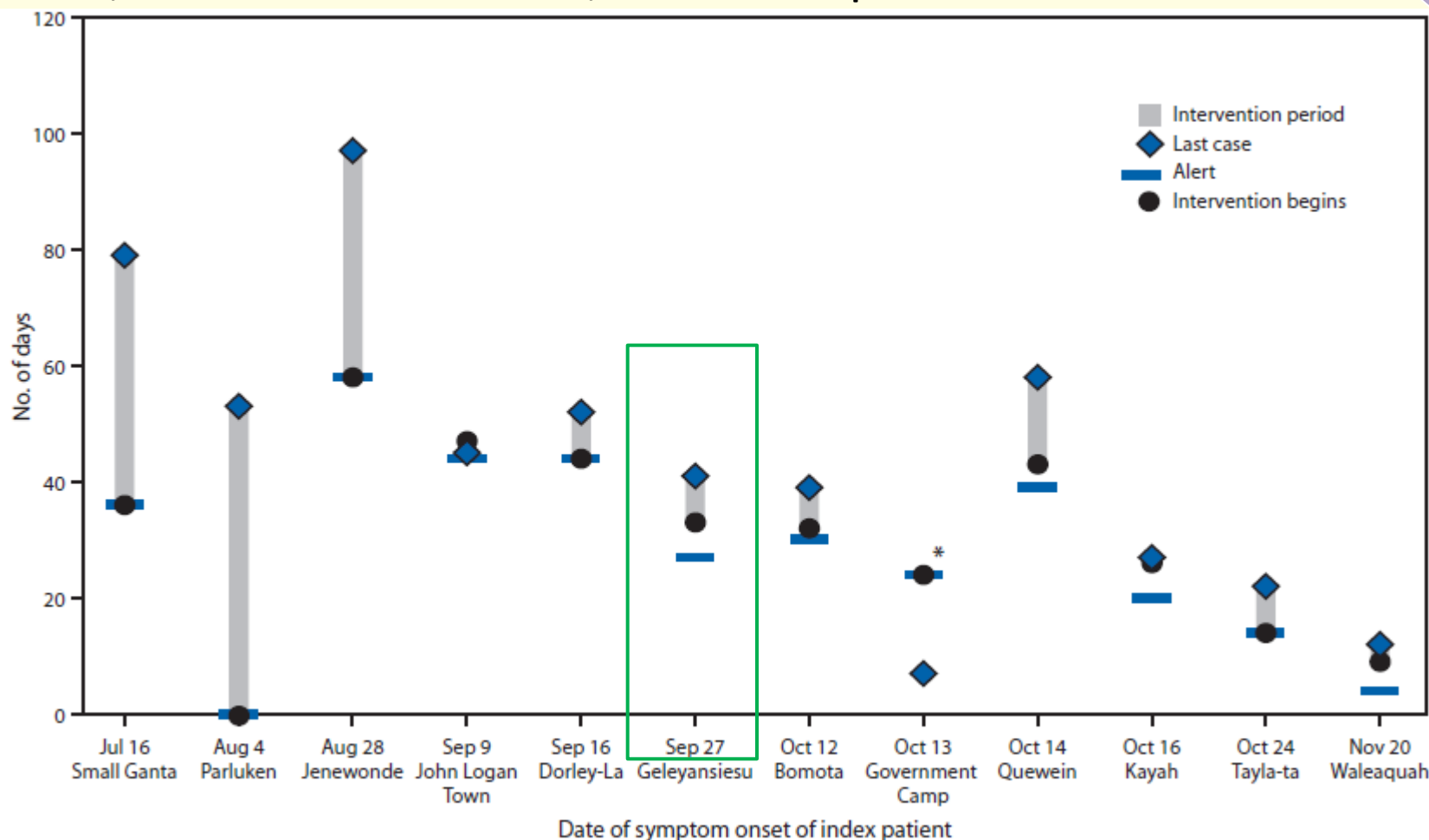


Blackey et al. MMWR 64(07); 175-178

The “RITE” Stuff: Controlling Ebola

Number of days from symptom onset to alert County Health Teams, start of intervention, and last reported case

Liberia



Blackey et al. MMWR 64(07); 175-178

The “RITE” Stuff: Controlling Ebola



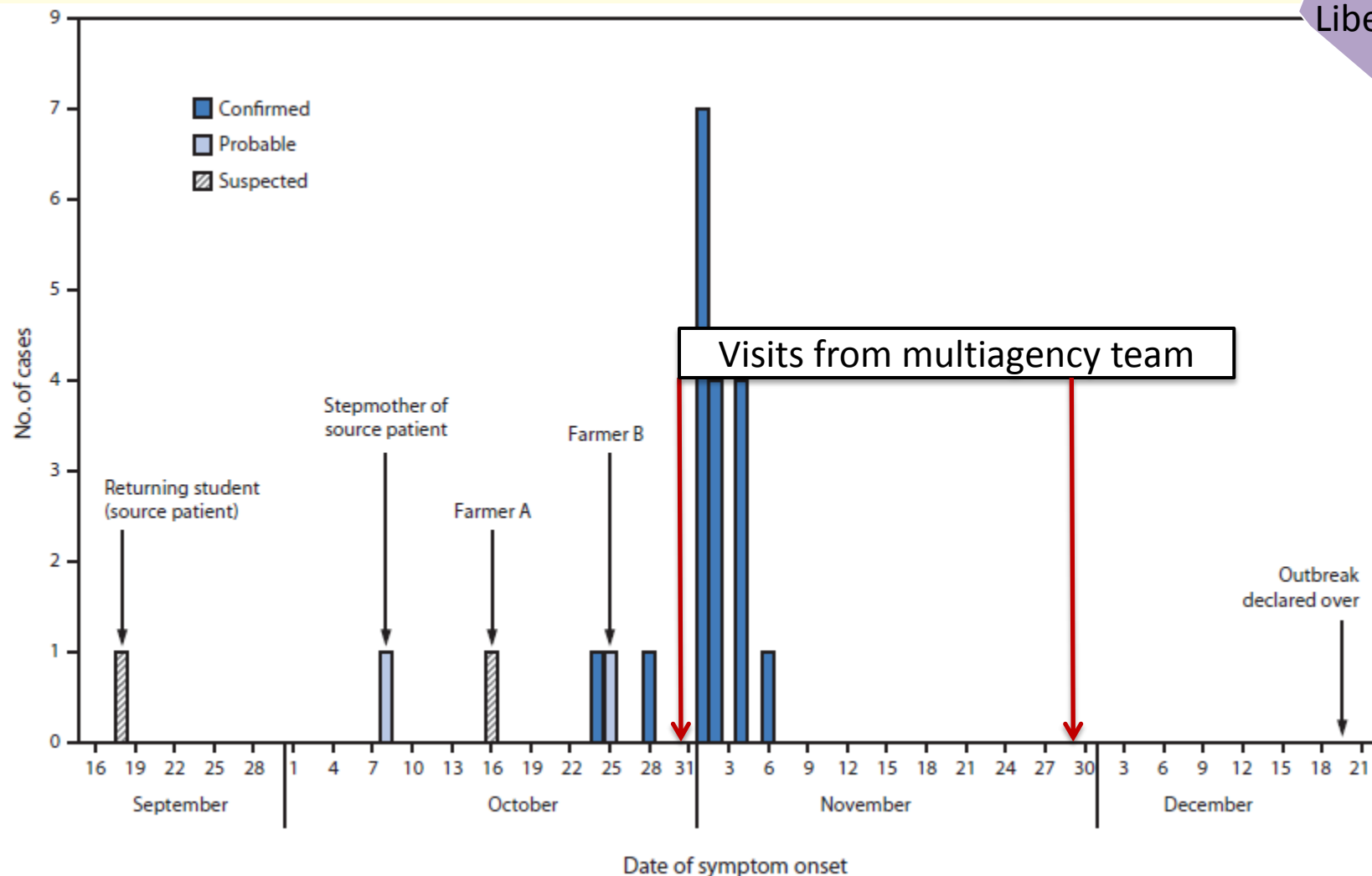
Liberia

RITE intervention in Geleyansiesu, Gbarpolu County

October 30	Visit from multi-organization assessment team.
November 3	Seven residents left the village for Bong Ebola treatment unit.
November 4	All residents tested positive for Ebola (5 expired).
November 9-11	Assessment team return for follow-up visit.
November 29	Follow-up visit from multi-organization team.

The “RITE” Stuff: Controlling Ebola

Number of cases of Ebola by date of symptom onset



Kateh et al. MMWR 64(07); 188-192

The “RITE” Stuff: Controlling Ebola

Geleyansiesu: Population = 800



- **22 total cases were identified.**
 - (18 confirmed, 2 probable, and 2 suspected)
 - 16 deaths (CFR= 73%)

- “A multidisciplinary team including domestic and international partners supported the community in responding to the outbreak, which was effectively controlled with interventions...”

How Nigeria Controlled Ebola



Nigeria

Index case: Liberian who flew to Lagos while ill

July 20

Case arrived in Lagos and was confirmed to have Ebola at private hospital. National public health emergency declared.

July 23

Government agencies activated Ebola Incident Management Center.

July 25

Index case expired.

July 27 – August 31

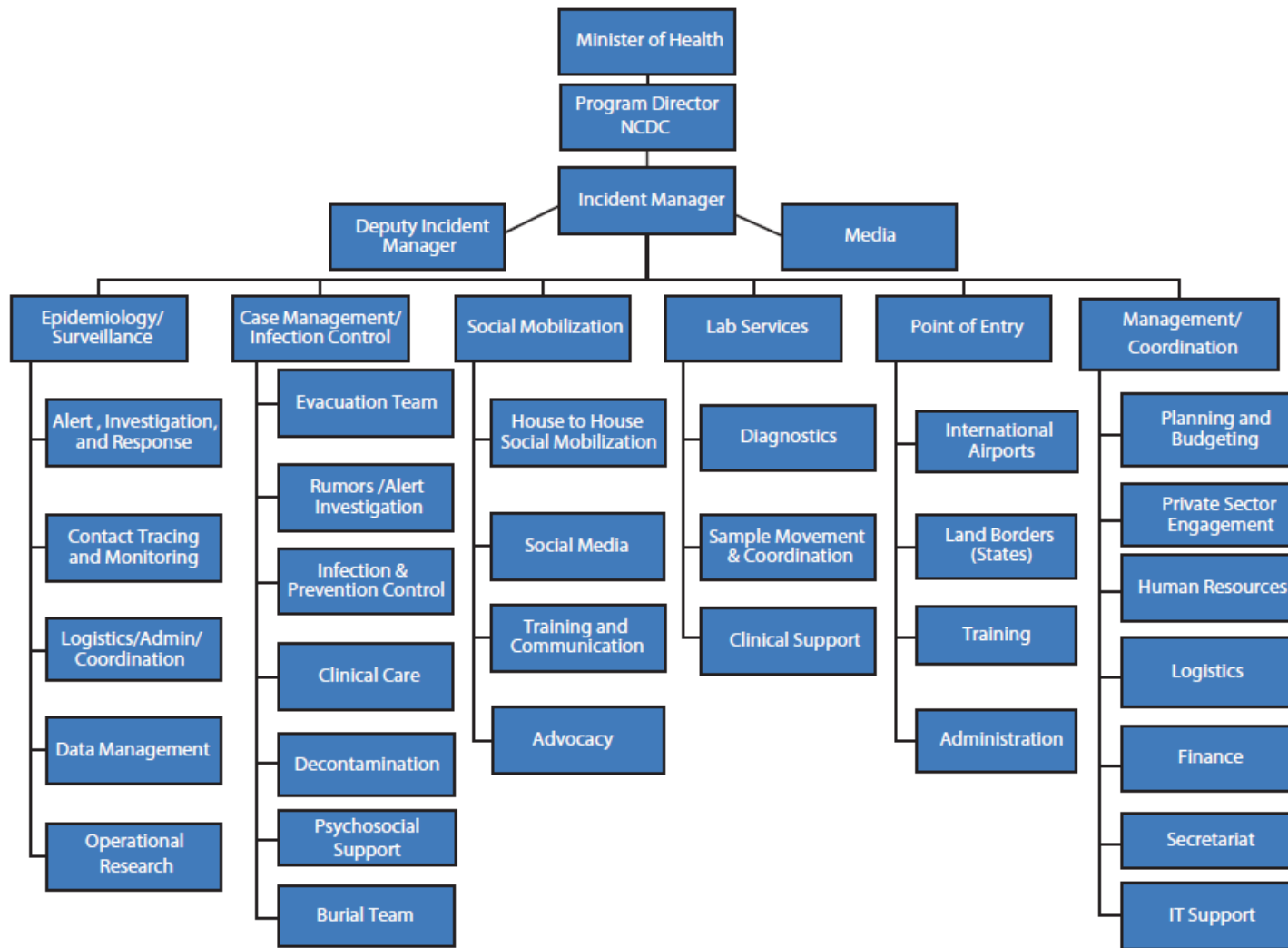
19 new Ebola confirmed and probable cases are identified in Nigeria.

October 20

Nigeria declared Ebola-free.

How Nigeria Controlled Ebola

FIGURE 2. Organizational structure of the Ebola Response Incident Management Center — Nigeria, July–September 2014



Nigeria

Response Teams

How Nigeria Controlled Ebola

Important considerations

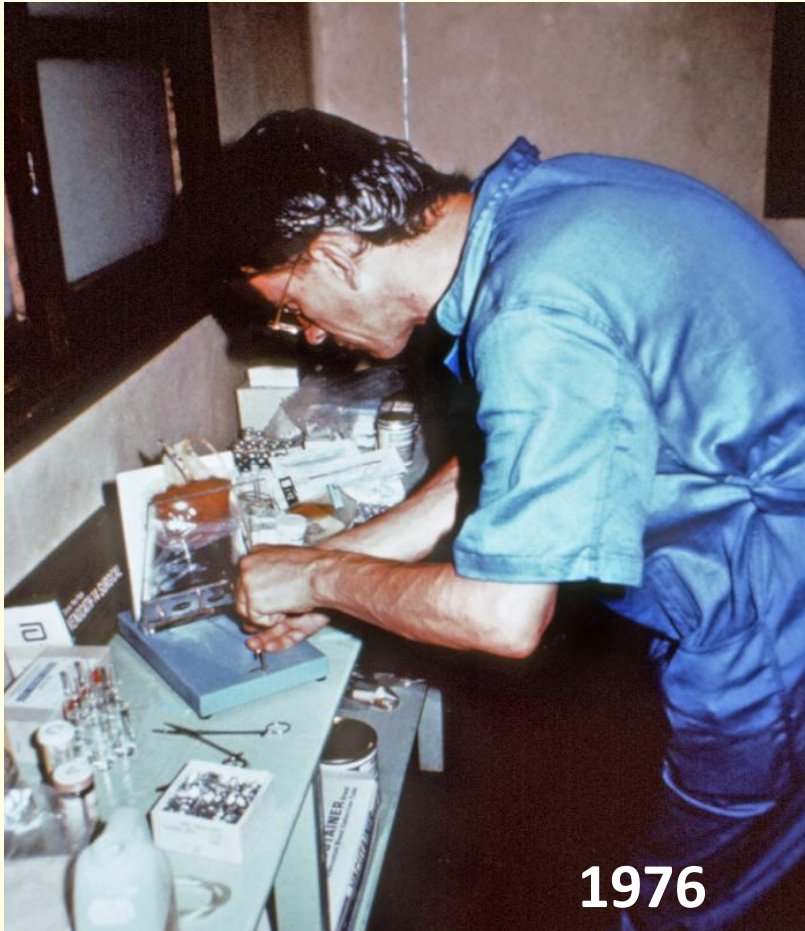


- Early preparation and coordination
- Immediate emergency declaration
- Trained local doctors
- Fear management
- Kept open borders
- Prepared for more patients
- Advocated international response

Food for Thought



Food for Thought



Food for Thought

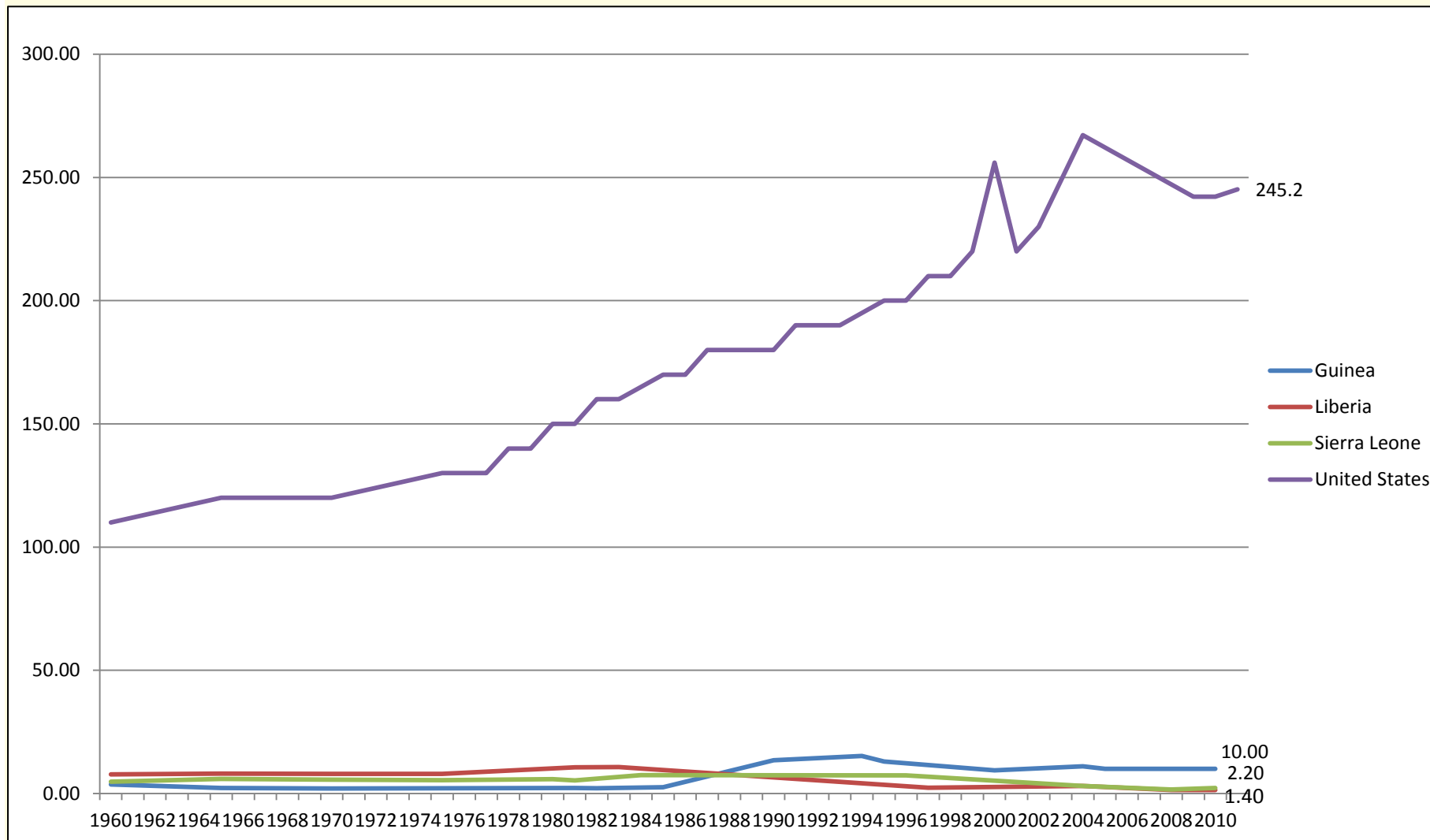


Food for Thought



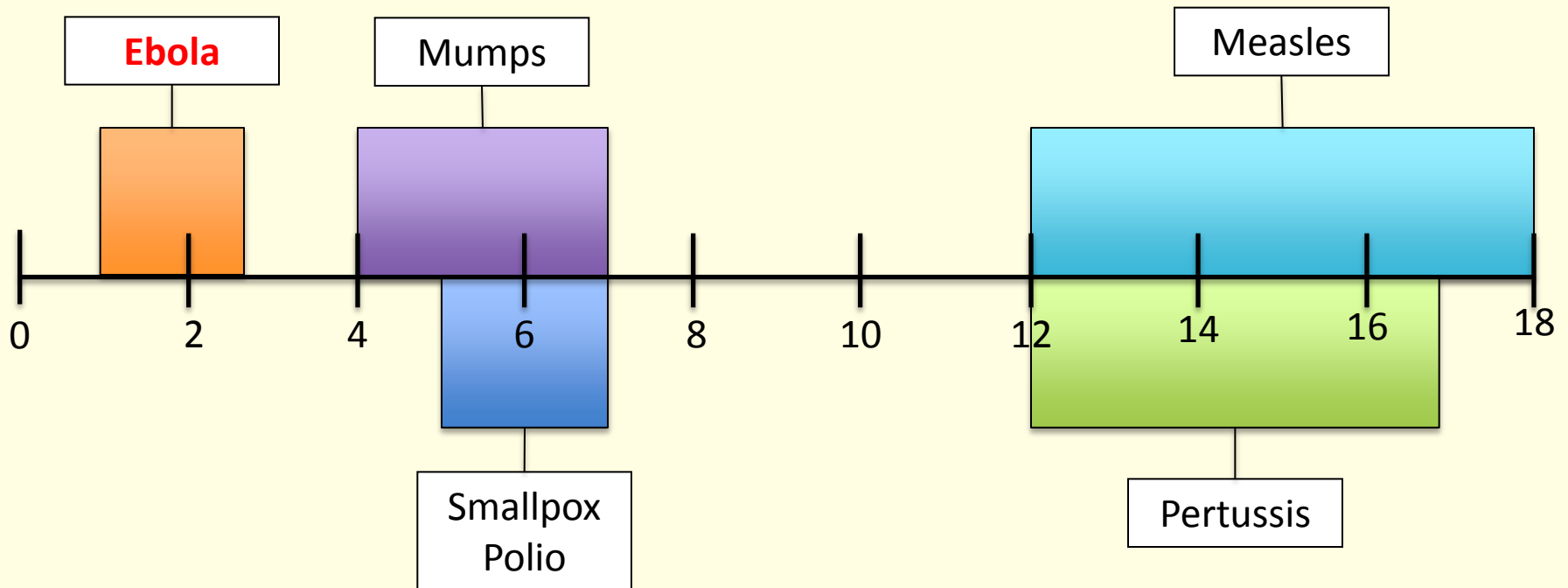
Food for Thought

Number of physicians per 100,000 people



Food for Thought

How many new cases are expected to become infected from one case?



Expected transmission of Ebola to other cases is low compared to other diseases.

Food for Thought

- **Ebola, the African experience, is complicated.**
 - Poor infrastructure, lack of access/education, previously unknown in this area, fear/distrust, countries recovering from civil war, poverty

- **Ebola is a disease that targets compassionate people.**
 - Healthcare workers
 - Persons nursing loved ones

- **Healthcare settings are ideal settings for transmission of Ebola.**
 - Accumulation of body and blood fluids
 - Many opportunities for infection control breaches

Food for Thought

- Ebola is not nearly as easily spread as other common diseases and requires very close contact for transmission.
- R_0 smallpox = 5-7 R_0 pertussis = 12-17 R_0 measles = 12-18
- Early isolation and treatment can control and prevent Ebola.
- The 2014 outbreak is not over until there are zero cases.

The End



CDC

**PLEASE FILL OUT THE
“THE AFRICAN EXPERIENCE” PRESENTATION
EVALUATION.**

THANK YOU!

Contact

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